

Suggested Performance Measures

Applicants for the CALFED Water Use Efficiency Grants Program are required to propose a method (or “performance measure”) of quantifying the actual benefits of their project. Quantification of project benefits is an important means of determining the relative effectiveness of various water management efforts, as well as the overall effectiveness of the CALFED Water Use Efficiency Grants Program.

The following information is intended to provide applicants with examples of some acceptable performance measures that may be used to estimate pre-project benefits and to verify water saved or marketed after the project is completed. **However, the following is not intended to be an exclusive list of acceptable performance measures. Applicants are encouraged to propose alternatives to the measures listed below, if another measure is more effective for the particular project.** Reclamation understands that in some cases baseline information may not be available, and that methods other than those suggested below may need to be employed. If an alternative performance measure is suggested, the applicant must provide information supporting the effectiveness of the proposed measure as applied to the proposed project.

Canal Lining or Piping

Canal lining or piping projects are implemented to decrease canal seepage and evaporation.

Pre-project estimations of baseline data:

To calculate potential water savings, physical measurements of seepage losses are necessary. Two testing procedures which can be used are listed below:

- Ponding Tests: Conduct ponding tests along canal reaches proposed for lining or piping.
- Inflow/Outflow testing: Measure water flowing in and out of the canal reach, taking evaporation into consideration.
- If ponding or inflow/outflow tests cannot be performed, document the estimated historical seepage and evaporation rates for the canal reach based on historical knowledge.

Post-project methods for quantifying the benefits of canal lining or piping projects:

- Using tests listed above, compare pre- and post-project test results to calculate water savings. For inflow and outflow testing, remember to consider losses from evaporation.
- If ponding or inflow/outflow tests cannot be performed, benefits can be calculated by comparing the estimated historic seepage and evaporation rates for the canal reach to the post-project seepage and evaporation.
- Results can be verified using a ratio of historic diversion-delivery rates. Also include a comparison of historical canal efficiencies and current canal efficiencies. For example, if an irrigation district needed to divert 6 acre feet of water to deliver 2 acre feet of water to a field through an unlined or unpiped canal, this would be a 67% inefficiency ($[100\% - (2AF/6AF * 100)] = 67\%$ inefficiency). If after lining or piping the canal, the irrigation district only needed to divert 4 acre feet of water to deliver the 2 acre feet; this would be a 17% improvement in efficiency ($[100\% - (2AF/4AF * 100)] = 50\%$ inefficiency).
- Record reduction in water purchases by shareholders and compare to historical water purchases. Use of this method would require consideration and explanation of other potential reasons for decreased water purchases.

For more information regarding canal seepage monitoring and verification, <http://www.agwatercouncil.org/WMP/Canal%20Lining%20Protocols1.pdf>

Measuring Devices

Good water management requires accurate water measurement. Potential benefits derived from measurement include:

1. Quantification of system losses between measurement locations
2. Accurate billing of customers for the actual amount of water used
3. Facilitation of accurate and equitable distribution of water within a district
4. Implementation of future system improvements such as remote flow monitoring and canal operation automation

Installation of measuring devices may include but are not limited to the following:

1. Flow meters
2. Weirs
3. Flumes
4. Meter gates

Pre-project estimations of baseline data:

Pre-project flows are difficult to estimate without a measuring device in place. However, the applicant may be able to use data from measurement devices

located elsewhere in the delivery system (if available). Otherwise, the applicant may have to rely on other historical data.

Post-project methods for quantifying the benefits of projects to install measuring devices :

- Compare post-project water measurement (deliveries or consumption) data to pre-project water uses.
- Compare pre- and post-project consumptive use by crop via remote sensing information.
- Survey users to determine utility of the devices for decision making.
- Document the benefits of any rate structure changes made possible by the installation of measuring devices. For example, if districts are able to convert from billing water users at a flat rate to billing for actual water use using a volumetric or tiered water pricing structure. (Assumes non-metered to metered district),

New Technologies for Improved Water Management

A. Data Acquisition

Proposals may involve the installation or expansion of a Supervisory Control and Data Acquisition (SCADA) system that monitors flows in an individual district or in a basin including several districts. SCADA systems provide water managers with real-time data on the flow and volume of water at key points along a water delivery system. Access to such data allows water managers to make accurate and timely deliveries of water, reducing over-deliveries and spillage at the end of the canal.

Pre-project estimations of baseline data:

- Collect data on diversions and deliveries to water users, making estimates if necessary.
- Document employee time spent pre-project on ditch/canal monitoring and water control.

Post-project methods for quantifying benefits of SCADA system projects:

- Calculate amount of increased carryover storage in associated reservoirs. This is a long-term measure which will be more meaningful over a period of years.
- Track and record the diversions to water users and compare to pre-project diversions. This would show results of improved management if yearly fluctuations in weather are accounted for.
- Report delivery improvements- i.e. changes in supply, duration or frequency that are available to end users because of SCADA.
- Document other benefits such as less mileage by operators on dusty roads (which saves time and influences air quality) and less damage to canal banks due to fluctuating water levels in canals.

B. System Control

Proposals may include system automation projects aimed at *preventing* spillage from canals, or drainage capture/reuse projects focused on *intercepting* spills and redirecting them to drains, canals or re-regulation reservoirs for reuse.

1. Spillage Reduction through System Automation

Pre-project estimations of baseline data:

- Establish baseline data by measuring existing spillage or document historic spillage. A rated measuring device should be positioned to measure spillage losses. To account for temporal variations, a minimum of one year history of pre-project measurements is desirable for future comparison to post-project water usage. Spillage volumes can vary substantially between wet and dry years; therefore, some multi-year estimates of spillage may be necessary.
- Track pre-project water diversions using district or state diversion records.

Post-project methods for quantifying benefits of spillage reduction projects:

- Using rated devices, measure post-project flows . Gather enough data to account for seasonal and temporal variations. Using baseline and post-project data, calculate savings using the following formula: Savings = (Spillage)_{w/o project} – (Spillage)_{w/project}.
- Track post-project changes in the amount of water diverted and compare to pre-project diversion data.
- Compare estimated historic spills from district/project boundaries to post-project spills.
- Document how the additional water resulting from the reduction in spillage was used; i.e., water retained in the river to support riparian habitat, transferred for another use, or used to meet normal water demands in times of drought.
- Report specific volume changes to spills, diversions or deliveries due to system automation.

For more information regarding canal seepage monitoring and verification, visit <http://www.agwatercouncil.org/WMP/Spillage%20Reduction%20Protocols.pdf>

2. Drainage Reuse Projects

Drain water reuse can be a district level or regional conservation effort that consists of recovering residual irrigation water from drains and returning it to the water supply system for delivery to users.

Several types of projects can focus on drainage and reuse including:

1. Pump stations with constant flow rates
2. Variable speed pump stations without SCADA controls
3. Variable pump stations with SCADA controls

4. Storage reservoirs with pump stations and constant flow rates
5. Storage reservoirs with variable speed pump stations and SCADA controls

Pre-project estimations of baseline data:

- A rated measuring device should be positioned to measure drain water losses. To account for temporal variations, a minimum of one year history of pre-project measurements is desirable for future comparison to post-project water usage. Drainage volumes can vary substantially between wet and dry years; therefore, some multi-year measurements of drain water losses may be necessary.

Post-project methods for quantifying benefits of drainage reuse projects:

- Using rated devices, measure post-project flows. Gather enough data to account for seasonal and temporal variations. Using baseline data and post-project data, calculate savings using the following formula:

$$\text{Savings} = (\text{Drainage}_{\text{w/o project}} - \text{Drainage}_{\text{w/project}}) + (\text{Spillage}_{\text{w/o project}} - \text{Spillage}_{\text{w/project}})$$
- Take readings from measuring devices positioned to measure drain water loss. A system analysis can be done with the following equation: $\text{Drainage}_{\text{w/project}} = (1 - \% \text{Reuse}) * \text{Drainage}_{\text{w/o project}}$
- Measure and record post-project water deliveries to fields, tailwater volumes entering reservoirs and tailwater volumes recycled to fields. Compare this data to previous history.
- Estimate any benefits to farmers, such as improved flexibility in water management, reduction in shortages of supply to tailenders, etc. If it is not possible to quantify these benefits in acre-feet, a narrative explanation is acceptable.

For more information regarding drainage reuse monitoring and verification, visit:
<http://www.agwatercouncil.org/WMP/Drainage%20Reuse%20Protocols.pdf>

C. ET Controllers

An ET controller automatically adjusts the amount of water applied to landscape based on weather conditions. The "smart" ET controller receives radio, pager or internet signals with evapo-transpiration information, so that watering is limited to the replacement of only the moisture that the landscape lost due to heat, humidity and wind. Other controllers use historical data to adjust the watering program.

Pre-project estimations of baseline data:

Domestic (interior) water usage: In many cases landscape water use and domestic water use are measured together. In these cases, domestic water use can be estimated and then subtracted from the total water use to estimate landscape water use using one of the following methods:

1. Domestic water use can be estimated based on the number of persons in the household and type of plumbing (low-flow or not).
2. Domestic usage can also be estimated using the assumption that landscape water is negligible during certain parts of the year, and therefore,

$$\text{Domestic Usage} = (\text{Average Use per Capita})_{\text{determined non-irrigation season}}$$

Once the domestic usage value is obtained, landscape water applied can be calculated using the following formula:

$$(\text{Landscape water applied})_{\text{w/o ET Controllers}} = \text{Total water use} - \text{Domestic Water}$$

Post-project suggested methods for quantifying benefits of ET Controllers:

- To calculate water savings, the following formula can be applied:

$$\text{Estimated Savings} = N [(\text{Average amount of landscape water applied per participant})_{\text{w/o ET Controller}} - (\text{Average amount of landscape water applied per participant})_{\text{w/ ET Controller}}]$$

$$N = \text{number of participants (households or landscapes)}$$
- Compare meter readings prior to ET controller installation and post-installation.
- Compare actual water applied post-project to estimated water application if only using sprinkler controller on a set timer application.

For more information regarding ET Controller monitoring and verification, visit:
<http://www.agwatercouncil.org/WMP/On-farm%20Protocols.pdf>

D. On-Farm System Improvements

On-farm system improvements increase the efficiency of the irrigation system by reducing water losses from deep percolation and unrecoverable tailwater.

Irrigation system improvements may include:

1. Converting to more efficient irrigation systems based on crops, soil, terrain and weather conditions
2. Upgrading existing irrigation systems (i.e. shifting sprinkler nozzle size, upgrading to surge irrigation)
3. Improving irrigation scheduling, management or delivery methods

Pre-project estimations of baseline data:

Documentation of water savings based on delivered water is complicated by the fact that crops are rotated from year to year, and weather patterns and water availabilities also change. However, one should record on-farm water deliveries and crop ET of irrigation water to make post-project comparisons possible.

Post-project methods for quantifying the benefits of on-farm improvements:

- Record post-project on-farm water deliveries and crop ET of irrigation water and apply the following formula:
$$\text{Savings} = [(\text{On-farm delivery}) / (\text{Crop ET})]$$

- ET of irrigation water) _{w/o project}] – [(On-farm delivery)/(Crop ET of irrigation water)] _{w/ project}
- Monitor delivery to affected fields and calculate water savings using delivery records and formula above.
 - Compare post-project volume of water applied and runoff with the historical water volume applied and runoff
 - Document the Distribution Uniformity (DU) of the original system and compare it to the new system DU because yield and water savings may be difficult to document over a 1 year study period due to yearly and crop variations.

For more information regarding canal seepage monitoring and verification visit:
<http://www.agwatercouncil.org/WMP/On-farm%20Protocols.pdf>